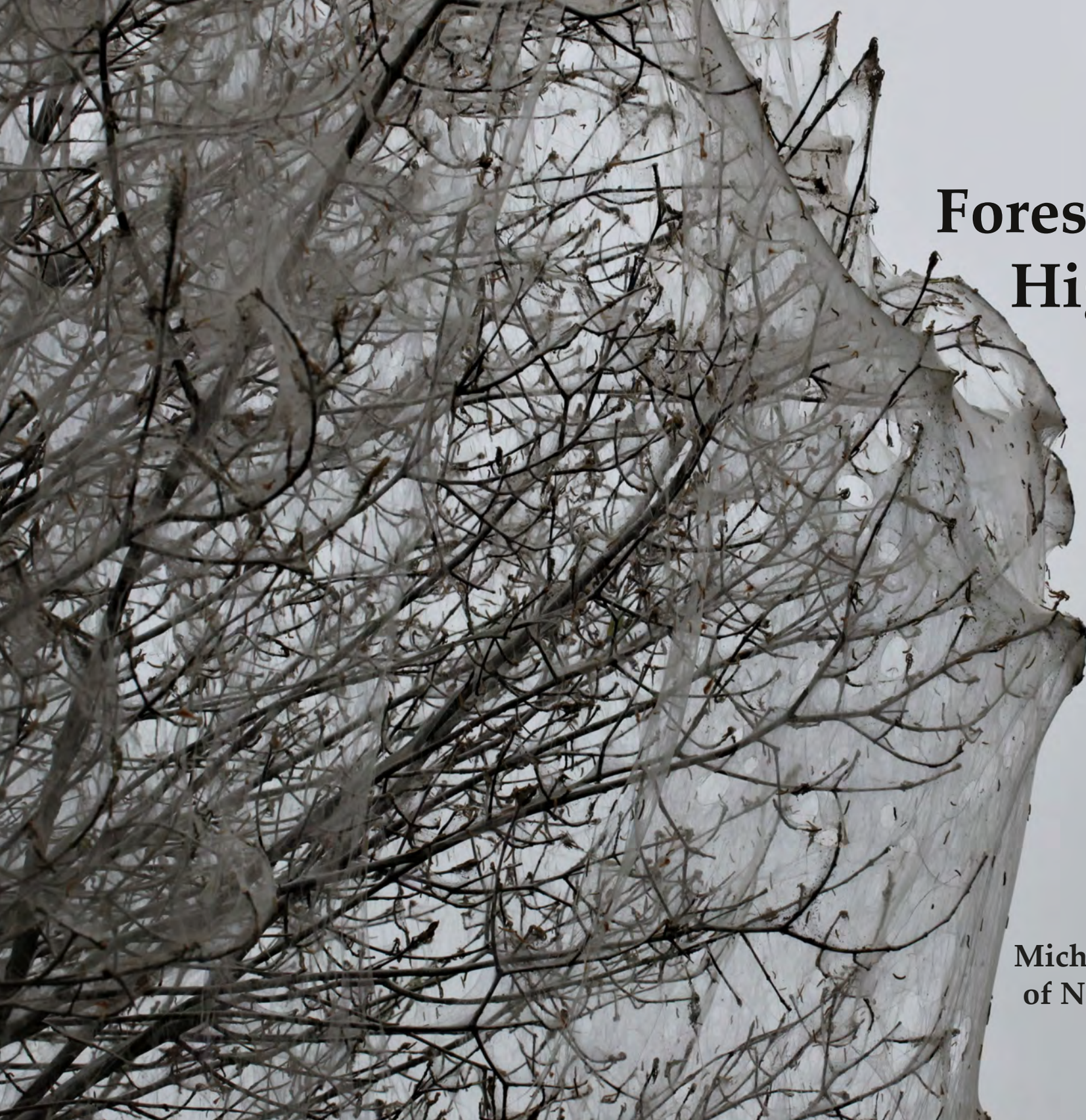

2018 Forest Health Highlights

Michigan Department of Natural Resources

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Cover photo: Colonies of Euonymus caterpillar, introduced from Europe, completely envelop and defoliate a Euonymus shrub. Photo by Michigan Department of Natural Resources forest health specialist Scott Lint.

The Michigan Department of Natural Resources is committed to the conservation, protection, management, use and enjoyment of the state's natural and cultural resources for current and future generations.

For more information, visit www.michigan.gov/foresthealth.

Acknowledgments

Forest Health Highlights is a summary of the condition of Michigan's forests during 2018 and the work done to preserve and protect them by the Michigan Department of Natural Resources Forest Resources Division and its partners.

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Introduction

Forest land plays an important role in Michigan's economy including forest products, recreation and tourism. Forests also improve our environment by helping to ensure clean air, water and wildlife habitat.

With more than 20 million forested acres, Michigan has more forest land than any other state in the Northeast or Midwest. Among the 50 states, Michigan ranks 22nd in land area and 10th in forest land area.

Unfortunately, Michigan's urban and rural forests are being threatened by a variety of forest health issues. The Forest Health Highlights publication is dedicated to informing foresters, landowners, arborists, homeowners and community leaders about work the Michigan Department of Natural Resources and its partners are doing to protect the health of the state's exceptional forests.

Since the 1970s, the DNR Forest Health Program has worked with university, state, federal and other partners to help citizens and land managers protect, manage and sustain urban and rural forests. This year the DNR is pleased to announce that several new staff have been hired to carry on the program.

The program has three new forest health specialists to cover the state. James Wieferich covers Southern Michigan and comes from the Michigan State University Forest Entomology Lab. Scott Lint covers Northern Lower Michigan and was a DNR forestry technician for many years. Simeon Wright covers the Upper Peninsula and was a forest pathologist with the Missouri Department of Conservation for seven years.

This year, we also established a Forest Health Response Team to assist with survey and treatment of hemlock woolly adelgid and other forest health field work. Our team consists of DNR foresters Andy Hallfrisch and Cheryl Nelson and forestry technician Sarah Itchue. This team has begun extensive survey efforts and treatment for hemlock woolly adelgid. They also will be assisting with *Heterobasidion* root disease and oak wilt projects.

We look forward to a new era in the forest health program and I hope you find the forest health highlights interesting and informative.

- Debbie Begalle
State Forester and Chief of DNR Forest Resources Division

This project was funded in whole or in part through a grant awarded by the USDA, Forest Service, Northeastern Area State and Private Forestry. The USDA is an equal opportunity provider and employer.

Big things from 2018:

- **Hemlock woolly adelgid:** A coordinated statewide strategy to combat hemlock woolly adelgid focused on surveys, outreach and education for landowners with hemlock, research, treatments and regulations on hemlock movement out of infested counties.
- **Oak wilt:** The DNR implemented oak wilt control measures at 18 sites across the state, separating 13,500 feet of tree roots with a vibratory plow.
- ***Heterobasidion* root disease:** The DNR created a public viewer so people can report suspected infections, see where the disease is known and learn about management practices to prevent it and limit its spread.

Hemlock Woolly Adelgid

You likely won't see the hemlock woolly adelgid with your naked eye. The tiny, sap-sucking insect is no more than 1.5 millimeters in size. But it's important to keep an eye out for their white, cotton-like ovisacs in infested trees.

The hemlock woolly adelgid – known as HWA for short – is an invasive species that is being detected in areas along the eastern Lake Michigan shoreline at a concerning rate. Surveys indicate that HWA is established at multiple locations within a four-county area in west Michigan posing a real threat of expanding if not acted upon quickly.

Michigan's 176 million hemlock trees are a key part of forest ecosystems. The insects can kill healthy trees within four to 10 years. A loss of hemlocks could change forest ecosystems throughout the state, threatening habitat for animals and aquatic life.

Adelgids likely were introduced to Michigan on infested landscape trees before the state implemented its exterior HWA quarantine in 2001. Current infestations were detected beginning in 2015 in Park Township in Ottawa County. In January 2017, the first detection of HWA on state-managed property was found at P.J. Hoffmaster State Park.

Hemlock woolly adelgid-infested hemlock branch.

Known infestations range as far south as Ganges Township in Allegan County up to Charles Mears State Park in northern Oceana County. Densities of infestations vary from a single or a few infested trees on an individual property to several thousand infested trees spread over hundreds of acres. State agencies and local groups are working together to identify infestations and eradicate them to stop the insect from spreading further across the state.

Hemlock decline.

To slow the spread of HWA, the Michigan Department of Agriculture and Rural Development (MDARD) enacted an interior state quarantine effective July 5, 2017. It regulates movement of hemlock materials out of and within Allegan, Muskegon, Oceana and Ottawa counties. It regulates hemlock nursery stock, not-composted chipped/shredded/ground or mechanically processed forest products containing hemlock; and hemlock forest products bearing twigs and needles, including branches, boughs, logs, lumber and firewood.

MDARD also maintains and enforces the exterior state quarantine enacted to prevent new introductions of HWA. In addition, MDARD maintains an HWA nursery program that may authorize growers and

Hemlock Woolly Adelgid

Aestivating (dormant) hemlock woolly adelgid nymphs at the base of needles.

dealers who participate to ship hemlock nursery stock out of and within the regulated counties. Currently, 21 Michigan firms have compliance agreements with MDARD.

Natural barriers surround the known HWA infestations on three sides. To the west is Lake Michigan and to the east of the lake, hemlock density significantly decreases after only a few miles. To the south of the known infested areas in Allegan County, hemlock density significantly decreases as well. That puts the focus on the forests to the north.

In 2017, a committee convened to create a coordinated statewide strategy to help manage HWA. Priorities include: prevention, detection, treatment, biological control, research, data collection/management, coordination/communication and identifying long-term funding sources. Both long and short-term objectives are being considered. The committee includes representatives from MDARD, the DNR, the USDA-Forest Service, Michigan State University and Ottawa County Parks and Recreation.

In mid-2018, the DNR's Forest Resource Division's Forest Health Program created a response team to help detect, manage and monitor pests and diseases in Michigan forests. One of its main objectives is to help implement the statewide strategy in response to HWA. The team includes a forester from each of the Cadillac and Baldwin DNR offices. One is working as the survey and treatment crew leader and the other is working to lead up outreach and communication. A forest technician from the Grayling office also is helping with all aspects of forest health concerns with a primary focus on HWA survey, treatment and outreach.

Hemlock presence in Michigan's state parks ranges from scattered understory to mixed hardwoods to dense stands that stabilize critical dunes. In each setting, hemlock play an important role for the recreational experience and for wildlife, including rare species of birds, that utilize stands.

The DNR's Parks and Recreation Division also hired six staff through the Michigan Civilian Conservation Corps in partnership with AmeriCorps, to look for and treat HWA infestations in state

HWA and weather

Hemlock woolly adelgid development, survival and control: influence of lake effect weather and efficacy of systemic insecticides

Deborah G. McCullough, Justin T. Keyzer and Alex Y. White
Michigan State University

Unlike most insects that spend the winter in a dormant state, hemlock woolly adelgid actively feeds and develops in winter. A second generation feeds and develops more rapidly in late spring and early summer.

In the eastern U.S., cold winter temperatures have reportedly caused high adelgid mortality. However, temperatures reported to kill the insects vary considerably among studies. Moreover, lake effect weather may ameliorate winter temperatures and deep snow may protect the adelgids from colder temperatures in the upper canopy.

Researchers are evaluating microclimatic differences in winter by monitoring ambient temperatures. Temperatures

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were recorded by attaching microthermal sensors to hemlock shoots at three heights and four aspects of trees in two infested sites. Infested shoots are periodically collected, returned to the lab and examined to assess hemlock woolly adelgid life stage, density and survival rates. Results will be integrated with research currently underway to project statewide hemlock distribution and to evaluate the current and future climate. The projects will help

Weather stations record temperatures on hemlock shoots.

to identify locations at high risk of damage if adelgid infestations expand.

Scientists also established replicated trials in 2016 and in 2018 at two locations to assess the efficacy of systemic insecticide

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Hemlock Woolly Adelgid

parks. They began insecticide treatments of infested areas in state parks at P.J. Hoffmaster in 2017. To date, six additional state parks are also combating HWA including: Saugatuck Dunes, Holland, Muskegon, Duck Lake, Silver Lake and Charles Mears.

Surveys and treatments continued in 2018 with a primary focus on Silver Lake State Park. There, the forest health response team helped the parks' crews treat all hemlocks within 800 feet of a known infested hemlock tree. PRD surveys led to the discovery of a small infestation in Charles Mears State Park, confirmed in August 2018. The parks crew was able to rapidly treat all hemlock at Mears within days of detection.

All hemlock at Ludington and Orchard Beach state parks have been surveyed and no new detections have been found. Parks' crews will survey state parks in the northern Lower Peninsula and Upper Peninsula in the coming months.

Collaboratively, Ottawa Conservation District is surveying and treating HWA on private lands to complement surveys and treatments done by the DNR. They have surveyed and treated most of the private land in and around Silver Lake State Park and Mears State Park in Pentwater. When treatments are finished, a barrier of treated trees will theoretically separate healthy hemlock north of Mears State Park from known infestations further south, slowing the spread of HWA into the large northern Michigan hemlock resource.

What is the likelihood of success? Infested areas in Michigan are still relatively small, with most of the hemlock range in the state still uninfested. Viable treatment methods do exist and can be implemented over a broad scale within the known infested sites. This insect also appears to be susceptible to mortality during Michigan's cold winters. It is possible that some of Michigan's forests could be suboptimal for HWA survival.

Coordinated detection, treatment and regulatory efforts should substantially slow the movement of HWA outside of the known infested counties. This provides time for the evaluation of more long-term integrated management tactics such as biological control and the development of resistant or tolerant trees before HWA spreads farther.

It also allows time to fully evaluate the threat HWA poses to hemlock trees in colder parts of the state and potential restoration alternatives.

In the meantime, statewide outreach and education on HWA continues. For more information about HWA, visit Michigan.gov/HWA

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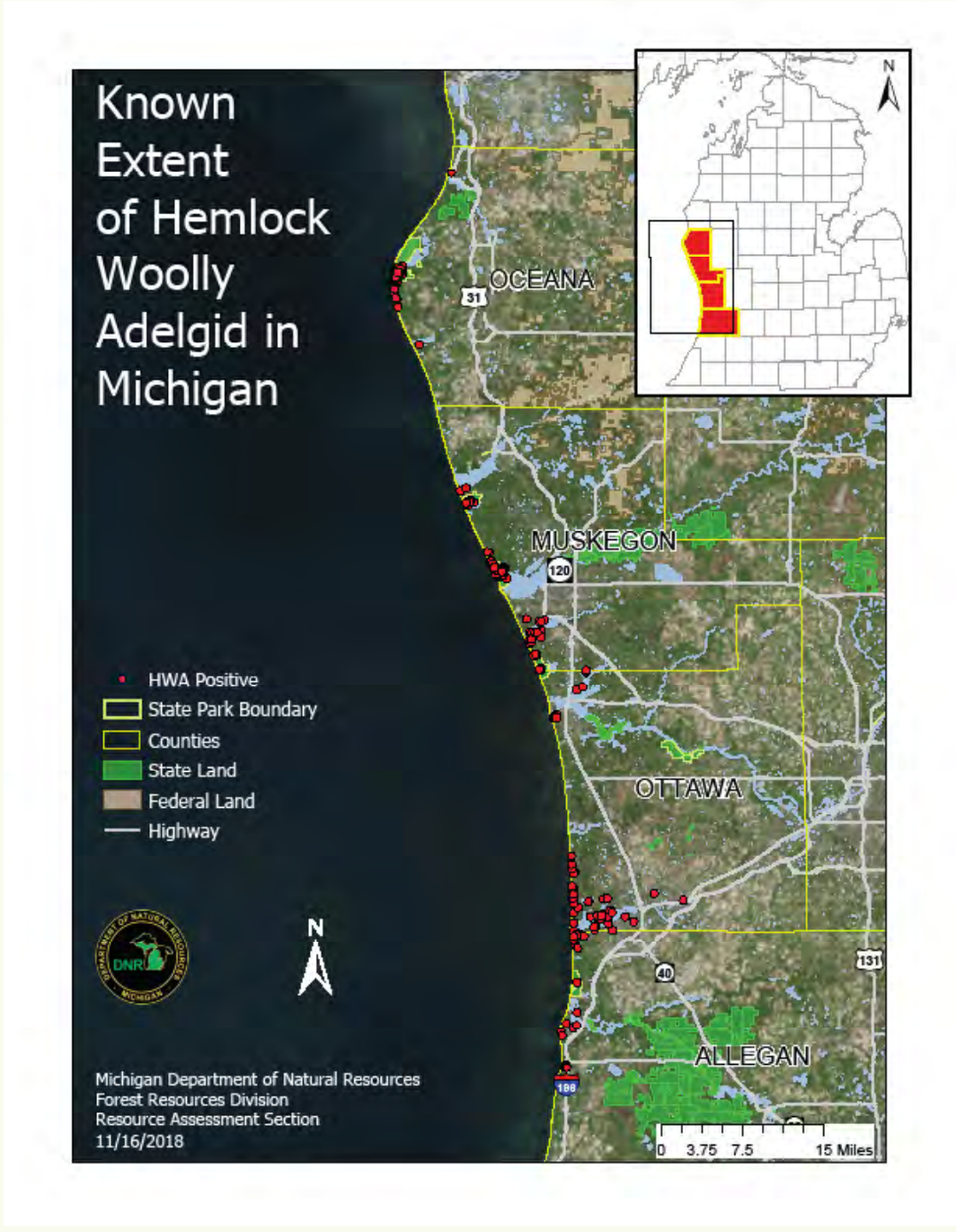

Healthy hemlock.

products for hemlock woolly adelgid control. To prevent any risk to soils or water near Lake Michigan, the products are primarily applied either by injecting the insecticide into the base of the tree trunk or by spraying the lower three to four feet of the trunk, which allows the insecticide to move through the bark and into the vascular tissue of the tree. Infested shoots from treated and untreated trees are examined at two to three week intervals. Data allow researchers to monitor the development of both adelgid generations and to compare the effectiveness of the insecticides, how quickly they control the insect and how long control persists.

Watchlist: Spotted Lanternfly

The spotted lanternfly is the newest addition to Michigan's invasive species watchlist. The list includes species that have the potential for significant ecological, social and economic impacts, but are not yet well established in the state.

The lanternfly is native to Asia and has been growing in numbers in eastern Pennsylvania since it was first detected in 2014. It has spread to additional states including Delaware, Maryland, New Jersey, New York and Virginia.

Spotted lanternfly is a threat to several hardwood species, including black walnut, oak, willow, maple and sycamore, as well as Michigan's fruit and nursery industries. Spotted lanternfly pierces trunks, branches, twigs and leaves to feed on sap, removing sugars and other nutrients. Oozing wounds leave grayish black trails along the bark of the tree. The insect also excretes a sticky "honeydew" that coats plant surfaces, allowing sooty mold to grow. That blocks light and reduces photosynthesis.

Like many invasive species, the adult spotted lanternfly is a showy insect and catches everyone's eye from mid-July through October, when flies are active. The adult is about an inch long with a gray, black-spotted forewing. When the lanternfly opens its forewings, the hindwing is visible. It is bright red with a black tip separated by a white strip. Spotted lanternfly nymphs are commonly mistaken for ticks. Young nymphs are small and black with several white dots; the final nymph stage is red-and-black with white spots.

Similar to gypsy moth, spotted lanternfly can move long distances by laying eggs on objects that later are moved to new locations. With extensive outreach and education, we hope to raise awareness and promote decontamination of vehicles and trailers that may cross through eastern Pennsylvania and inadvertently spread the spotted lanternfly.

Is there anything you could be doing? Keep your eyes open! Early detection of watch list pests helps protect our forests. Learn about the pests that are endangering Michigan forests at Michigan.gov/Invasives and know the next steps. If you find an insect that may be a spotted lanternfly or other watchlist species, or a tree that may be infested, take photos, record the location, collect the beetles/hoppers in a jar and contact: 1-800-292-3939 or MDA-Info@michigan.gov.

Adult spotted lanternfly. Photo credit: Pennsylvania Department of Agriculture, Bugwood.org.

Watchlist: Asian Longhorned Beetle

Along with spotted lanternfly, Asian long-horned beetle (ALB), Anoplophora glabripennis, holds a space on the watchlist. As an exotic pest that feeds on maples and other species common in Michigan, ALB poses a real threat to our forests. This destructive pest has been detected in five states and Ontario, Canada, where thousands of trees have been killed. In Massachusetts, Ohio and New York, ALB continues to cause damage, but in some areas where detection occurred quickly, eradication has been successful.

About the Insect and Damage

ALB was first discovered in the United States in Brooklyn, New York in August 1996. Able to survive for long periods of time inside woody material, ALB most likely arrived in the USA on wooden pallets and other wood packing material shipped from its native range in Asia. Unlike most wood-boring insects, ALB is a generalist and can develop on many tree species such as horse chestnut, poplars, willows, elms, birches and black locust. However, species of maple are the preferred host.

Trees peppered with Asian Longhorned Beetle emergence holes, where the insect has bored its way out of the tree.

Eggs are deposited in pits chewed into the bark on branches or the trunk of the tree. After they hatch, the larvae bore into the xylem and heartwood of the tree, weakening the tree and diminishing the timber value. In large numbers, larvae can cause tree mortality.

Adults are glossy black with irregular white spots and can be ¾ to 1 ½ inches long, not including their long black-and-white striped antennae. Although the adults are large, you will rarely see them even in heavily infested areas. Instead look for signs and symptoms left behind by adult ALBs. Scars on the bark from egg laying pits, exit holes and piles of frass (sawdust-like material) are most commonly noticed. Pits are normally about the size of a dime, while adult ALB exit holes are roughly 3/8-inch diameter, large enough to insert a pencil.

Firewood is a major concern for dispersal of ALB. Consequently, intensive surveys are conducted every year in state parks and recreation areas in cooperation with DNR's Parks and Recreation Division and citizen volunteers. Trees near campground fire rings are monitored closely due to the risk from infested wood. Camper zip codes are used to help target campsites visited by campers from ALB infested areas. In addition, Michigan Department of Agriculture and Rural Development and Michigan State University set up traps statewide to help detect ALB. After eight consecutive years of surveying DNR state parks and recreation areas and trapping statewide, no detections have occurred in Michigan so far.

Training of arborists, foresters, other natural resource professionals and volunteers continues. Observant, knowledgeable citizens will be critical in detecting and reporting this pest early for successful eradication efforts. Remember, if you find or see anything you suspect may be an Asian long-horned beetle, report it to: 1-800-292-3939 or MDA-Info@michigan.gov.

Beech Leaf Disease

Michigan beech trees – already threatened by beech bark disease – now face another potential threat. Although not detected in Michigan, beech leaf disease is affecting American beech trees in northeast Ohio, northwest Pennsylvania, southwest New York and in southern Ontario. There are reports of tree decline and mortality in Ohio, where beach leaf disease was first detected in 2012. Beech bark disease-resistant American beech and European beech also have displayed symptoms. Little is known about beech leaf disease, however research in Ohio and Ontario suggests it may be caused by a species of nematode (microscopic worm).

Initial symptoms of beech leaf disease are dark, slightly thickened bands between leaf veins. As symptoms progress, the leaves become more distorted and puckered. Eventually, the entire canopy may have sparse foliage with small, chlorotic (yellow) or dark, leathery, puckered or swollen leaves. If you suspect you have observed symptoms of beech leaf disease in Michigan, consult the following website: https://bygl.osu.edu/node/885 to help rule out other possibilities, then take photos, record the location, and contact: 1-800-292-3939 or MDA-Info@michigan.gov.

Top: Beech trees seriously affected by beech leaf disease. Bottom: Beech leaves showing signs of the disease.

Oak

Oak Problems
During 2018, oak decline, oak wilt and oak skeletonizer were primary issues observed and reported among Michigan's oak trees. Knowing the cause is important in understanding and managing the long-term impacts to the oak resource.

Oak decline
In 2018, oak decline affected northern pin and red oak across the northern Lower Peninsula. Oak decline refers to a loss of tree growth and vigor, leading to tree dieback and death. Affected trees may appear to die rapidly or more slowly over several years. Unlike oak wilt, many of the dead leaves may remain attached to the branches. Oak decline usually is caused by several factors working together. In 2018, some of these factors included drought, poor site quality (nutrient-poor sandy soil that exacerbates drought impacts), and advanced tree age (many of these trees are reaching their maximum lifespan, having grown after widespread logging in the early 1900s). Other events, including 2017 gypsy moth defoliation and Lecanium scale infestation, were also factors at some locations. Once the trees become stressed, they are no longer able to defend themselves from secondary diseases and insects that attack stressed oak trees, such as Armillaria root rot and two-lined chestnut borer. These secondary pests are often what kill the affected trees.

Armillaria root rot is caused by a native fungus that

Armillaria mycelial fan on an oak. Photo credit: USDA Forest Service, Bugwood.org

is common in oak forests and may cause little apparent damage to healthy oak trees. Once trees become stressed and more vulnerable to infection, roots and lower stem tissues are attacked and killed. To confirm Armillaria root rot, chip or peel away bark from the root flare and base of the trunk of dying and dead trees. A thin layer of mycelium (white fungal material) will be present between the bark and wood of the tree.

Oak wilt vectors

Olivia Morris and Deborah G. McCullough
Michigan State University

Oak wilt, an important forest health issue in Michigan, is caused by a fungus *(Bretiziella fagacearum)*, which can be vectored by tiny beetles in the family Nitidulidae. These insects feed on pressure pads formed by infected trees, then introduce the fungus into wounds on healthy red oaks. We are monitoring activity of these insect vectors, determining the proportion bearing oak wilt fungal spores and identifying volatile compounds produced by healthy and wounded red oaks in three northern Michigan forests. We are also tracking xylem

Wind-oriented traps are used to capture sap-feeding nitidulid beetles that can carry oak wilt spores.

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development of red oaks in these sites to determine when trees begin producing thick-walled latewood, which may be less vulnerable to fungal infection. Six traps were placed at each site and baited with aggregation pheromone lures for *Carpophilus sayi* or *Colopterus truncatus*, which were identified in other states as important oak wilt vectors. Traps were checked and lures replaced at two-week intervals from April through October. More than 1,140 nitidulid beetles representing 20 species were captured and identified. Collaborators at MSU report surprisingly few beetles were carrying viable oak wilt spores. Contaminated beetles represented four species, C. *sayi*, C. *truncatus*, *Glischrochilus fasciatus*, and C. *dimidiatus* and most were captured in May. Examination of cores collected throughout the season showed trees began producing latewood by mid-June. Volatile organic compounds collected from healthy and wounded trees at the three study sites, and from pressure pads on additional trees are currently being analyzed to identify specific compounds that may attract nitidulid beetles to wounds or pressure pads.

An exposed pressure pad on a red oak infected with oak wilt.

Oak

Two-lined chestnut borer is a native beetle attracted to stressed oak trees. Healthy trees will not attract adults and a vigorous tree can often fight off invading beetles. Larvae feed under the bark of branches and eventually the trunk, destroying the tissues that conduct water and nutrients, girdling branches and entire trees. Two-lined chestnut borer can be confirmed by peeling bark on dead or dying branches and trunks of dying trees to look for meandering tunnels and thin white larvae underneath.

Two lined chestnut borer larvae and damage

The best management practice for oak decline is prevention through maintenance of healthy, vigorous trees. On state land, foresters thin or remove older trees allowing younger, more vigorous stands to develop. Some marginal sites are converted to other species, such as pine, which are better adapted to the local conditions.

Oak Wilt

Oak wilt is an aggressive fungal disease caused by *Bretziella fagacearum*, killing many oaks in Michigan every year. Oak wilt continues to spread into new areas when untreated firewood from infected trees is inadvertently transported long distances, and when oak trees are wounded from April 15 to July 15. Wounds in the spring and early summer are visited by sap-feeding insects that can carry the oak wilt fungus. Infected trees die rapidly, just a few weeks after symptoms first appear. Epicenters (expanding pockets of infected trees) develop with trees that died in earlier years at the center, and additional trees dying at the margin each year as the fungus slowly spreads from infected trees to adjacent healthy trees through connected root systems.

In contrast, oak decline may appear more random or affect large numbers of trees across the landscape. In addition, once trees are infected with oak wilt, they usually drop many of their leaves, starting in the upper crown of the tree. Oak decline may occur more slowly with progressive dieback or result in a canopy of brown dead leaves. Oak wilt confirmation is important so that management decisions can be made. Oak wilt is confirmed by a positive lab test or the presence of fungal pressure pads under the bark of a tree that died the previous year.

Oak

A tree affected by oak wilt in Isabella County.

Several activities address oak wilt in Michigan. Arborists, local conservation district foresters and DNR staff educate private landowners about the risks of oak wilt infection and assist with confirmation of the disease. In addition, the U.S. Forest Service provides oak wilt suppression funds to the DNR to help eliminate oak wilt from public forest land through detection and treatment of new epicenters. At the margin of an epicenter, a vibratory plow is used to cut a narrow, 5-foot-deep trench to separate the roots that connect oak trees, preventing the spread of the disease through the root system. Once infected trees are isolated from healthy trees, they can be removed to prevent a source for the overland spread of the disease via insects prior to April, when the risk of new infections increases. In 2018, 18 sites in the northern Lower Peninsula and western Upper Peninsula were treated, for a total of 13,500 feet of vibratory plow line.

An online oak wilt map created by DNR Forest Resources Division shows confirmed and suspected locations in Michigan as well as locations where treatments have occurred. The map also includes links to additional information on oak wilt and tools for reporting new or suspected locations of oak wilt for follow-up by DNR forest health staff. To use the viewer, visit www.michigan.gov/foresthealth and click on "View and report oak wilt locations".

Oak Skeletonizer

In late summer 2018, reports of heavy red oak defoliation by oak skeletonizer (*Bucculatrix ainsliella*) were received in Emmet County along M-119 from Harbor Springs to Cross Village. Limited damage was observed elsewhere in both the Lower and Upper peninsulas. Heavily damaged trees developed a brown color and early leaf-drop, leading to confusion with oak decline and oak wilt.

Oak wilt control

Monique Sakalidis and
Karandeep Chahal
Michigan State University

A team of MSU researchers is working to refine Michigan-specific oak wilt control measures. This involves looking at what time of year trees are most likely to be infected, when they are most susceptible to the disease, when the spore-spreading beetles are most active and when the fungus is producing spores.

The team includes MSU faculty Deborah G. McCullough, Bert Cregg and Monique Sakalidis, who are working with graduate students Karandeep Chahal and Olivia Morris.

To determine when trees are most susceptible to oak wilt, the team has completed monthly inoculations of red oak trees at three research sites from August to October in 2017, and April to November in 2018. All the trees inoculated in 2017 died except the ones inoculated in October 2017. In 2018, trees inoculated from April to June died, trees inoculated in July and August are declining and trees inoculated September to November were not symptomatic by November 2018. The team will conduct further inoculations April-November 2019 to see if the

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pattern of rapid mortality early in the growing season is consistent with what was observed in 2018.

Currently, no mycelial mats have been produced on inoculated trees. The team has been working with DNR forest health personnel to determine when viable spores are produced by *Bretziella fagacearum* (the fungus that causes oak wilt). From April to November 2018, six mats were collected and screened each month for viable spores of the fungus. Viable spores have been detected on mats collected in April (1/6), May (3/6) and June (1/6). No viable spores have been detected on mycelial mats collected from July-September 2018. Collection and screening will continue throughout 2019.

The team also has been screening the beetles Morris has collected from different sites around Michigan for viable spores. This involves macerating the beetles in water, plating out the liquid onto agar plates and then waiting for cultures that look like B. *fagacearum* to grow. Of the 1,374 beetles screened we have generated 11,180 agar plates. Of these, 20 beetles carry spores of B. *fagacearum*. Cultures of the pathogen obtained from beetles were confirmed using colony morphology, and microscopic characteristics of the fungal propagules. Moreover, DNA barcoding of few representing cultures will be used for molecular confirmations of B. *fagacearum*. The beetle species that were carrying the pathogen were: *Carpophilus dimidiatus, Carpophilus sayi, Colopterus truncatus* and *Glischrochilus fasciatus*. We will continue screening the beetles that Morris collects throughout 2019.

This tree died in 2017. Reddish-brown streaking visible on the sapwood as well as a ripened fruit odor were apparent in the early spring of 2018. It is likely that mycelial mats will form on this tree by late spring/early summer of 2018.

The team is working with the MSU Diagnostic Lab to evaluate molecular methods of oak wilt. Members hope to develop a rapid molecular method for oak wilt detection, speeding up the process of diagnostics from two weeks to a single day. We are also evaluating methods of sampling symptomatic trees to determine if there is an alternative to branch sampling for oak wilt detection.

Oak

However, most oak skeletonizer damage appears late in the growing season and individual leaves have a skeleton-like appearance from the feeding of the larvae on the underside of the leaf.

Oak skeletonizer damage.

Oak skeletonizer periodically increases to outbreak levels on red oak trees and is native to Michigan. The small green larvae feed on the underside of leaves between the veins, giving them a skeleton-like appearance. Because the oak skeletonizer usually remains at outbreak levels for only a couple years, there are few reports of tree decline or death after infestation. Control measures are not necessary.

Oak skeletonizer becomes a nuisance when the larvae spin their cocoons on buildings and other items nearby in the landscape.

Heterobasidion Root Disease

Heterobasidion root disease (HRD), formerly known as annosum, annosus or fomes root rot, and caused by *Heterobasidion irregulare*, is one of the most economically damaging forest diseases in the northern hemisphere. Although thought to be native, HRD was first reported in southern Michigan in 1963. Red, white and jack pine in actively managed plantations are especially vulnerable to infection. In recent years HRD has been detected primarily in red pine plantations. Ongoing survey activities over the past eight years have resulted in many new detections. HRD has been confirmed in 18 Lower Peninsula counties and a single Luce County location in the Upper Peninsula.

Heterobasidion *root disease fruiting bodies.*

Most infection occurs when spores released from fruiting bodies of the fungus land on freshly cut stumps. Once the stump is infected, the fungus slowly grows through the roots that are grafted, or connected, between trees. Eventually, a pocket of dead trees develops. Once introduced, HRD becomes very difficult to eliminate, and is a threat to future conifer crops on that site. As the amount of infection at a site increases, more fruiting bodies (mushrooms) form, more spores are present and the risk of infection in adjacent areas increases.

Mortality in a young plantation after a previous heterobasidion *root disease establishment.*

The DNR is developing an advisory to protect Michigan's red pine resource. Currently, on state-owned land, an "advisory zone" of 5 miles around known infection sites is considered higher risk for infection. Forest health staff are taking a risk-based approach in implementing a timber sale contract specification that requires stump treatments or winter logging. As of Oct. 1, 2018, stump treatments or winter operations are required for all U.S. Forest Service red pine timber sale

Ash Borer

An Area-Wide Management Approach for the Invasive Emerald Ash Borer to Protect Urban and Natural Forest Ecosystems

Deborah G. McCullough and Andrew R. Tluczek
Michigan State University

Our overall goal is to develop, implement and evaluate an integrated management strategy to slow population growth of emerald ash borer and reduce mortality of ash trees in forested settings.

In early 2016, we extensively surveyed two sites in central Michigan at different stages of ash borer infestation. At one site dominated by green ash, nearly all overstory ash had been killed and most live ash were relatively small (3-4 inches diameter at breast height). At the second site, green ash growing in wet or swampy areas were dead, but live (and healthy) white ash remained abundant in the overstory.

We delineated 24 acres at each location and divided the areas into four, 6 acre blocks. In two blocks, we treated several ash trees with a trunk injection of TREE-äge®, a systemic insecticide that provides nearly complete

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emerald ash borer control for up to three years. We estimated that 35 to 40 percent of the live ash phloem was treated with the insecticide. We also released an EAB larval parasitoid in one block with treated trees and in another block with no insecticide treatment. One block in each area had neither insecticide treatment nor biocontrol. In June of 2016 and 2017, we selected pairs of ash trees in each block, girdled one tree of each pair, then debarked the pairs of ash trees in March of the following year.

Data analysis is continuing but the insecticide treatment reduced overall ash borer population growth in two treated blocks. The introduced parasitoids were recovered from both areas, although native parasitoids and woodpecker predation caused more ash borer mortality. Results show that systemic insecticides and biocontrols can be integrated and will slow rates of ash mortality.

The ash borer larva that made this gallery was parasitized by Tetrastichus planipennisi, as evidenced by the tiny white cocoons in the red circle.

Heterobasidion Root Disease

contracts, including those under the Good Neighbor Authority.

An online HRD map shows current confirmed locations of the fungus in Michigan and the 5 mile "advisory zone", as well as locations where surveys did not detect HRD. The map also includes an identification bulletin as well as tools for reporting new or suspected locations of HRD for follow up by DNR forest health staff. To use the map, visit www.michigan.gov/foresthealth and click on "View and report *Heterobasidion* root disease locations". Reporting potential HRD mortality pockets in managed red pine plantations will help protect our red pine resource for future generations.

Red pine plantation with a mortality pocket caused by heterobasidion *root disease.*

Forest Tent Caterpillar

Defoliation in Chippewa County.

Forest tent caterpillar is at it again. Since 2016, the caterpillars have defoliated 266,206 acres of maple, aspen and oak in northwestern Lower Michigan and the eastern Upper Peninsula.

Forest tent caterpillar outbreaks typically occur every eight to 12 years. The last was in 2009-2010, which means Michigan is due for another one. Thankfully, outbreaks consist only of two or three years of severe defoliation on a large scale, indicating that Michigan should see a population collapse within the next year or two.

The caterpillars are native to the eastern United States and Canada. In the spring, eggs hatch and young larvae feed on newly developing leaves. By late spring-early summer, larvae have grown and are able to strip trees of their foliage. Although affected trees will flush out a second set of leaves in late June and early July, this depletes the tree's energy reserves. Vigorous, healthy trees usually survive; however trees affected by drought or other issues may be killed after multiple years of defoliation.

Forest tent caterpillars are easily noticeable in part because they spin long, silken threads and mats in the trees they feed on. Young caterpillars use the silken mats to rest and/or molt in the upper canopy. Larger caterpillars congregate lower in the tree and

Forest tent caterpillar.

Detection

Early Detection of Non-Native Forest Insects

Paige Payter, Chase Hannahs and Deborah G. McCullough
Michigan State University

Researchers conducted a statewide trapping program designed to detect newly established species of non-native forest insects not known to be in the U.S. or in Michigan. The program is in collaboration with officials from the Michigan Department of Agriculture and Rural Development and USDA Animal and Plant Health Inspection Service.

Exotic forest pests of concern include insects that feed beneath the bark on phloem or wood, such as Asian longhorned beetle and European spruce beetle, as well as several moth species whose larvae feed on leaves or needles of forest trees. Early detection of major invasive forest pests is critical to minimize the damage they could cause.

Researchers identified sites at relatively high risk of exotic forest pest introductions and/or establishment resulting from (1) commodities imported from overseas and likely to be transported with solid wood packing material (e.g., crating,

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pallets) or (2) nursery trees, firewood or logs transported into Michigan from other states. In 2018, we set up an array of trap types baited with either pheromone lures or with host volatiles known to attract specific insects at 45 locations. More than 600 traps were monitored at these sites during the growing season. Trapping sites included forested sites near camping, recreation or wood-processing areas where firewood or harvested logs are a major threat and industrial areas that import steel or other heavy materials from international suppliers. More than 6,000 phloem or woodboring insects captured in the 2018 traps are currently being identified and MDARD personnel are examining thousands of bark beetles. Results to date, however, show that no Asian longhorned beetles or serious defoliators are known to be in Michigan in 2018.

A baited funnel trap may capture bark beetles, longhorned beetles or other woodborers. Insects are collected in the white cups at the base of the trap. Only a few beetles were captured in the cup above, but more than 200 beetles are sometimes caught in other sites.

Forest Tent Caterpillar

are forced to move to new vegetation in search of food as they defoliate entire forests. In Michigan, forest tent caterpillars have many natural enemies that keep outbreaks in check. One is a parasite known as the "friendly fly." This fly does not bite but can be a major nuisance to home owners during large outbreaks. However, the flies control caterpillar populations by laying eggs on the caterpillar cocoons. The maggots then feed on and kill the caterpillar pupae.

Forest tent caterpillars are often confused with their relatives, the Eastern tent caterpillar. Eastern tent caterpillar populations were also noticeably higher in 2018.

Can You Spot the Difference?

Forest Tent Caterpillar

- Yellow dots that look like a key hole
- Parallel blue lines on each side of the dots
- Spins long silken threads and mats in trees

Eastern Tent Caterpillar

- Solid yellow line running the entire length of its body
- Builds a tent

Top: Forest tent caterpillar. Bottom: Eastern tent caterpillar.

Emerald Ash Borer Quarantine

The interior quarantine restricted the movement of firewood in Michigan.

Effective Oct. 1, 2018, the Michigan Department of Agriculture and Rural Development (MDARD) repealed its Emerald Ash Borer Interior Quarantine. Although the tree-killing pest hasn't been found in four of Michigan's 83 counties, given their proximity to known infested and quarantined counties, it's highly likely that the ash borer is already present in them. In addition to Michigan, emerald ash borer has been detected in 34 states, the District of Columbia and five Canadian provinces.

Prior to the repeal, Michigan's interior quarantine regulated the movement of ash trees, ash logs, other ash tree parts and hardwood firewood from the Lower Peninsula into the Upper Peninsula, from the quarantined counties of the U.P. into the non-quarantined counties of the U.P., and from anywhere in Michigan to several Great Lakes islands.

The emerald ash borer interior quarantine meant businesses and individuals handling ash wood, untreated ash products and hardwood firewood had to sign agreements with MDARD on how they would reduce the risk of moving the pest into non-quarantined areas. The repeal of the state quarantine allows for free movement of ash wood and hardwood firewood throughout Michigan, relieving the regulatory burden on Michigan industries.

The federal emerald ash borer quarantine for interstate movement remains in effect. Businesses or travelers moving articles regulated by the federal quarantine out of the contiguous federal

Ash Borer Effects

Effects of Emerald Ash Borer on Riparian Forest Structure

Patrick Engelken and Deborah G. McCullough
Michigan State University

Rapid loss of a major overstory species can cause cascading effects within forest ecosystems. These effects could be especially significant within riparian forests, who exert influence on adjacent waterways as well as downstream. Prior to the emerald ash borer (EAB) invasion, species of ash were common across southern Michigan. Black ash and green ash are notably well-suited to hydric forest conditions and were often common in riparian corridors. Mortality of ash in these areas could potentially alter inputs of leaf litter, sunlight and woody debris to the forest floor and to streams, with subsequent effects on communities of microorganisms and invertebrates. Post-EAB regeneration within canopy gaps resulting from ash mortality is important in determining the future status of riparian forests and streams. In 2016 and 2017, we delineated 12 canopy gaps resulting from ash borer-caused ash mortality along an east-west gradient from southeast to southwestern Michigan. We

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recorded size, species and condition of overstory trees within each gap and in the surrounding forest at each site. We also surveyed regeneration, shrubs and herbaceous plants and coarse woody debris. Preliminary results indicate that more than 90 percent of overstory ash in the riparian forests have succumbed to emerald ash borer. In southeast sites invaded relatively early by emerald ash borer, dead ash trees have begun to fall, creating a pulse of coarse woody debris that has yet to occur in central and southwest sites where dead trees remain standing. Ash saplings are abundant within canopy gaps in all areas. Their ability to survive the ongoing ash borer presence will determine if these ash species will functionally persist as overstory components. Seedlings within canopy gaps were rare and high densities of sedges appear to be limiting additional seedling establishment.

Post-invasion ash mortality and fallen ash snags in riparian forests along first order streams.

Emerald Ash Borer Quarantine

quarantine area must continue to work with the United States Department of Agriculture to meet interstate requirements.

Michigan's quarantine helped to slow the spread of the ash borer, giving communities, land owners and managers the time to plan ahead of an infestation to ensure diversity in tree landscapes. Slowing the spread also provided an opportunity for research to catch up, helping to guarantee some ash will survive in the Michigan landscape in the future. It also allowed for timber salvage.

Firewood restrictions can still be enforced on private, state and federal lands. DNR is selling certified heat-treated firewood to campers at many state parks to prevent the introduction of pests and diseases that are increasingly being detected in the campgrounds. Certified heat-treated firewood eliminates those pests by being heated to 60 degrees Celsius for 60 minutes.

Campers and others are encouraged to know what rules are in place at their destinations. The best course of action is to obtain firewood near campgrounds, cabins or other destinations where the wood will be burned, and to not take unused firewood home.

Michigan continues to ask people not to move firewood as it can carry other pests and diseases, such as oak wilt, to new areas or bring in new pests or diseases.

USDA is currently pursuing deregulation of the emerald ash borer nationwide and shifting efforts into biocontrol. Get more USDA APHIS Emerald Ash Borer information.

Spruce Decline

Although new spruce budworm damage was very limited this year, many spruce in the Upper and Lower peninsulas still looked thin. Some needle loss on upper and outer branches could be due to past spruce budworm defoliation, and some needle browning last spring may have been due to winter injury. Some lower branch death may be due to canker diseases, but needle loss associated with lower and interior branches is also often associated with Rhizosphaera and Stigmina needle cast diseases. Branches with only the newest needles at the branch tips are common where infection has occurred. To confirm the needle cast diseases, look for rows of dark dots on shed needles. A hand lens makes this task much easier.

Extensive needle drop on lower branches due to needle cast diseases.

These diseases require extended periods of needle wetness for infection. In 2016 and 2017, wet weather during the growing season provided many opportunities for infection. The diseases took off on the lower branches where limited air movement and sunlight allow needles to remain wet longer. It can take several months for symptoms to develop after infection occurs. As the infection increased, additional infection became more likely in 2018 even if extended wet periods were less frequent due to the dry summer.

Management decisions depend on the situation. In an ornamental setting, fungicides can

Cankers

A new species of Diaporthe causes cankers associated with spruce decline on Colorado blue spruce in Michigan

Monique Sakalidis and
Keumchul Shin
Michigan State University

DNA sequencing of seven gene regions has revealed that there are two species of *Diaporthe* that have the ability to cause cankers on Colorado blue spruce, which is associated with spruce decline. The disease is prevalent in Colorado blue spruce on roadways and in landscaping around homes in Michigan.

One of these species, *Diaporthe eres*, is a well-known stem canker and leaf spot-causing pathogen found on many different plants in temperate regions around the world. The second species is new to science. Pathogenicity trials conducted during 2017 and 2018 have revealed that this new *Diaporthe* species is more virulent; it can cause larger cankers on Colorado blue spruce trees.

Of the 42 cultures of *Diaporthe*

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that have been collected, half are *D. eres* and half are the new *Diaporthe* species. The new species appears to be mainly in the north, central and west parts of the Lower Peninsula, while *D. eres* appears to exist throughout the Lower Peninsula. Further systematic sampling of trees is required to determine if there is a pattern to the distribution of each species.

An interesting phenomenon is often noticed in the landscape where we observe healthy trees adjacent to declining trees that appear to be heavily impacted by spruce decline. With support from the Michigan Department of Agriculture and Rural Development's Horticulture Fund, we have targeted these healthy trees to try to identify endophytic fungi that could be used as biocontrol agents against *Diaporthe*. We have isolated fungi from healthy and diseased Colorado blue spruce trees, identified them using DNA barcoding and then assessed their ability to inhibit the growth of *Diaporthe* in culture.

During 2019 greenhouse trials, we will evaluate our top-performing fungi showing antagonistic ability against *Diaporthe* by pre-inoculation of seedlings with the living cultures of the fungi, and following inoculation with *Diaporthe* cultures. We will then assess subsequent symptom development to see if any of the candidate fungi can be used as form of biocontrol against *Diaporthe*.

A dual culture assay showing the growth of Diaporthe (left) inhibited by another fungus (right) that was isolated from Colorado blue spruce.

Spruce Decline

Rhizosphaera fungal fruiting bodies on an infected needle.

protect highly susceptible Colorado blue spruce when applied before severe infection occurs. Pruning the affected lower branches off large spruce trees may increase airflow and eliminate a source of spores. Severely affected trees are unlikely to recover and should be removed. In large plantings, thinning or removal of competing vegetation may increase airflow and sunlight reaching trees, reducing the potential for infection. Native spruce tend to have some resistance and may be a better planting option. However significant needle cast infection was noted in 2018 on white spruce.

Spruce Budworm

In 2018, spruce budworm defoliation of spruce and fir trees was limited to a few areas in Michigan's western Upper Peninsula. Defoliation was much less extensive than in 2017, when extensive defoliation occurred in the Upper Peninsula and isolated areas of the northeastern Lower Peninsula. However, outbreaks of this native insect generally last 10-15 years and we anticipate severe defoliation over the next decade, following historical patterns of extensive defoliation and tree mortality across the northeastern United States and Canada every 30-40 years. Mature and over-mature balsam fir-dominated stands are most susceptible. Infested stands often lose 60 to 80 percent of the fir and 20 to 40 percent of the spruce. Michigan Department of Natural Resources staff continue to identify and harvest newly-defoliated and high-risk mature spruce and fir stands.

Management recommendations are to harvest spruce and fir trees when they reach an age of 50 years and to salvage stands with significant budworm damage. Other guidelines include:

- Monitor annual spruce budworm defoliation and presence of mortality from the top to the bottom of the tree.
- Consider harvesting stands with top kill and mortality.
- During an outbreak, prioritize salvage operations by:
- Harvesting stands with top kill or mortality.
- Harvesting oldest stands.
- Harvesting stands with the highest component of balsam fir.
- Harvesting stands with the highest volume.
- Recognizing that stands on poor sites may be damaged earlier and to a greater extent.
- When stands cannot be salvaged quickly enough, protect high-value stands with registered insecticides.

Top: Spruce budworm larva (or caterpillar). Bottom: Aerial view of spruce budworm defoliators.

Japanese Stiltgrass

Japanese stiltgrass is one of the most widespread and problematic invasive plant species in the eastern United States. The grass, which can significantly alter forests and reduce native plant and animal diversity, was found in Michigan in 2017. A single herbarium record from 2011 previously recorded stiltgrass on private land in Lenawee County.

Today, known populations include the vicinities of Niles (Berrien County), Ann Arbor (Washtenaw County.), and Brooklyn (Lenawee County.)

Volunteers work to remove a Japanese stiltgrass infestation.

The statewide network of Cooperative Invasive Species Management areas (CISMAs) has amplified outreach across Michigan, resulting in the timely discovery of populations in Berrien and Washtenaw counties in 2017. Early detection has allowed rapid response to these infestations which will mean better long-term outcomes for Michigan.

The Southwest X Southwest and Jackson-Lenawee-Washtenaw CISMAs have worked with the Michigan DNR to expand surveys, work with private landowners and remove stiltgrass by herbicide or torching early season growth. Partners are refining the use of herbicide to maximize recovery of alternative plant communities while still being able to effectively eliminate stiltgrass populations.

The extent of the known population in Lenawee County is less than one acre and was completely removed in 2018 with assistance from land managers. This not only met a management objective but was

Chesnut Gall Wasp

Michigan Developing an Integrated Management Strategy for Asian Chestnut Gall Wasp in Michigan

Louise Labbate and Deborah G. McCullough
Michigan State University

Michigan, the leading producer of chestnuts in North America, was not known to harbor the invasive Asian chestnut gall wasp until it was detected in Berrien County in 2015. A native of China, the wasp has been in the US since 1974 when it was detected in Georgia and populations have since been found in 11 other states.

Larval feeding causes galls to form on young chestnut shoots, which can limit their growth and reduce burr and nut production. When this pest invaded Italy, the leading producer of chestnuts in Europe, yields dropped substantially. A Chinese parasitoid introduced into Georgia for biocontrol of Asian chestnut gall wasp in 1977 has since dispersed naturally.

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In 2018, we monitored wasp activity, abundance and life stages, as well as parasitoid presence and rates, in seven orchards in southwest Michigan. Branches were sampled every two weeks to quantify gall density and one gall per branch was dissected to assess wasp life stages and parasitoid abundance. In late June, we placed traps to capture adult wasps in these orchards as well as eight additional locations to monitor spread. We determined dates and growing degree days associated with Asian chestnut gall wasp life stages, including adult emergence, parasitism rates and density of galls on different chestnut species and cultivars. Parasitism rates ranged from less than 5 percent to more than 25 percent of larvae. Adult wasps were trapped at 10 of the 15 sites, indicating Asian chestnut gall wasp can spread 30-40 miles in a year, probably due to wind-aided dispersal of adult wasps. Data from this project will be used to develop integrated management guidelines for commercial chestnut growers.

Left: Current (reddish color) and previous year (dark gray) galls on a chestnut shoot. Right: Adult Torymus sinesis parasitizing ACGW larva inside a gall.

Japanese Stiltgrass

important training to help these managers find early infestations on their conservation lands.

Populations in Washtenaw County span public and private land, while the Berrien County population is known across only a few acres. The Michigan DNR has provided funding for torching and treatment in 2019 in conjunction with work of the CISMAs to set up plans with impacted landowners.

In Lenawee, the City of Niles and Indeck Corporation are working to contain and eliminate the population. These CISMAS and the DNR have been able to conduct these early detections and responses by having built the existing partnerships which is an example of invasive species preparedness in action.

Japanese stiltgrass. Photo credit: Andrea Matthies

What can you do?

- Learn about invasive species at Michigan.gov/Invasives.
- Keep your eyes open! Early detection helps protect our forests.
- If you suspect a plant may be Japanese stiltgrass, take photos, record the location and report it to norwoodg@michigan.gov or 517-342-4514.

Japanese stiltgrass. Photo credit: Andrea Matthies

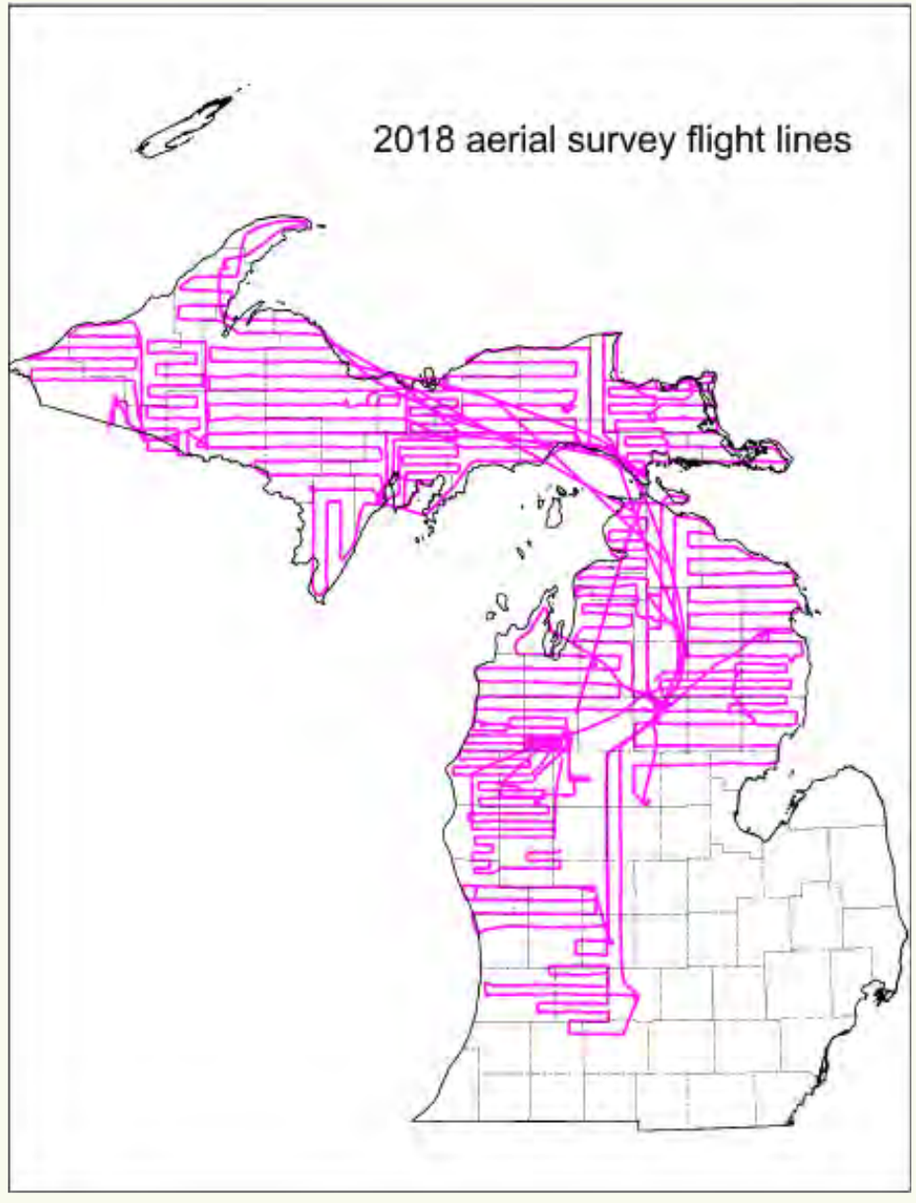
Aerial Survey and Digital Mobile Sketch Mapping

Each year, Michigan's nearly 20 million acres of forest land are surveyed for insect and disease damage by the DNR's Forest Health Program. These surveys occur throughout the growing season, in cooperation with the U.S. Forest Service (USFS) which conducts aerial surveys on National Forest lands.

Large areas of defoliation, discoloration, dieback and mortality are mapped during aerial survey missions. Aerial survey information is used to monitor damage and changes in pest populations from year to year and serves as an early detection tool for emerging problems. Foresters, other natural resource professionals and policy makers use this information to make decisions that improve the growth and health of our forests.

Damage from forest pests is mapped using Digital Mobile Sketch Mapping software on a tablet computer provided by the USFS Forest Health Assessment & Applied Sciences Team. Surveyors mark areas of damage they see out the window of the aircraft on satellite imagery as it scrolls by on the screen. Data is uploaded to a national data server. This allows aerial surveyors (sketch mappers) around the country to provide forest health staff and other professionals access to near real-time information.

Aerial surveys for many damage agents need to occur during peak defoliation, which is only visible for a few weeks before growth of new foliage masks its presence. With the addition of new forest health staff, our ability to complete the aerial survey in a timely fashion was significantly improved this year. Two veteran sketch mappers worked to train three new surveyors to assist with aerial survey data collection. Despite a period of limited aircraft availability during a week of very high fire danger this July, we were still able to accomplish our survey goals. The additional



Timber Salvage

Aerial survey makes timber salvage possible

A late August storm front that brought severe straight-line winds and microbursts and spawned at least one confirmed tornado caused significant damage to several thousand acres across the Lower Peninsula from Ludington east to Roscommon. Following the storm, state and federal foresters reported some large areas of severe damage with blocked roads and trails. They indicated there may be some significant widespread forest impacts.

Requests were made from local land managers for an aerial assessment of the extent of this damage. In early September, a targeted flight delineated locations of the more severe damage. This information was used to assist ground surveys and timber salvage efforts in the Manistee National Forest as well as on state forest land in the Cadillac Forest Management Unit. As a result of this survey and rapid response on the ground, over 2,000 acres of timber salvage was made possible in the wake of this storm.

Storm damage on state and federal forest land.

Aerial Survey

staff enabled us to fly two aircraft at the same time on multiple days allowing us to complete our surveys on time. In addition, the use of two surveyors per aircraft provides a complete picture of all areas flown (see map), something that has not always been possible in previous years.

Using additional personnel also enables more extensive ground verification, resulting in higher quality survey data.

Common Tree Concerns

Have you noticed ugly or discolored leaves? Foliar diseases of hardwoods were common this year. Infection occurs during wet spring weather.

Fortunately, many of these diseases cause little lasting damage to established trees. Control measures are usually unnecessary.

Blotchy lesions on maple leaves caused by anthracnose.

Dark blotchy lesions and **spring leaf drop** caused by anthracnose were frequently observed and reported last spring in southern Michigan. **Anthracnose** diseases are common on ash, maple, sycamore and white oak.

Maple tar spot was also prevalent on several maple species in locations across Michigan. Beginning in August, patches of black, raised material that looks like drops of tar can be observed on the upper leaf surface. Close observation of maple trees would show pale yellow spots when the infection began in late spring. Leaves infected with the tar spot fungus often drop early.

Tarspot lesions on a maple leaf.

Extensive leaflet drop caused by ash anthracnose.

White Pine Decline

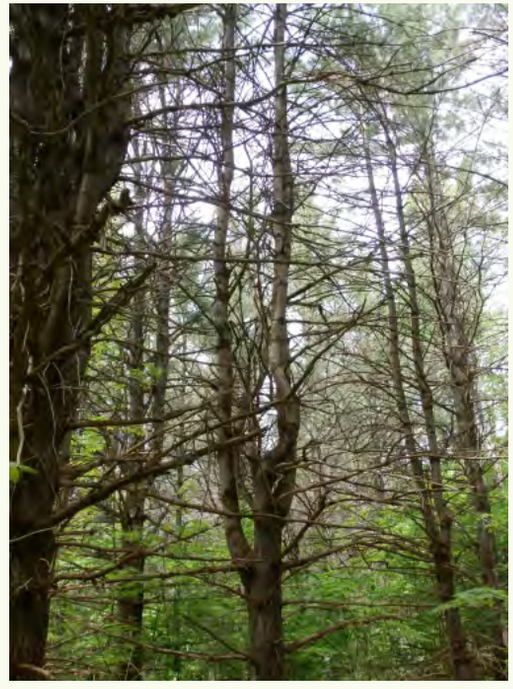
Michigan State Univeristy contributed this story

Eastern White Pine Pests: White Pine Weevil and Caliciopsis Canker Disease

By Katherine Minnix, Deborah G. McCullough, and Monique Sakalidis

Eastern white pine, an iconic forest species and the state tree of Michigan and Maine, is widely distributed in the Lake States region and much of the northeastern U.S. According to recent FIA data, more than 104 million eastern white pines currently grow in Michigan forests. Reports of declining trees have been increasing in the Lake States and northeastern U.S. for the past decade. There have been anecdotal observations of unusual mortality and branch death of white pine along the Au Sable and Manistee rivers in Michigan's north central Lower Peninsula. Mortality and dieback were initially observed primarily in regeneration (saplings, recruits), but reports indicate mature trees are now being affected. Symptomatic trees exhibit sunken red cankers on the bole and branches. These symptoms are characteristic of a disease caused by a fungal pathogen called *Caliciopsis pinea* that has been affecting eastern white pine in New England and in the Southern Appalachians.

The fruiting bodies (ascocarps) associated with cankers on eastern white pine.



Dieback in eastern white pine associated with Caliciopsis.

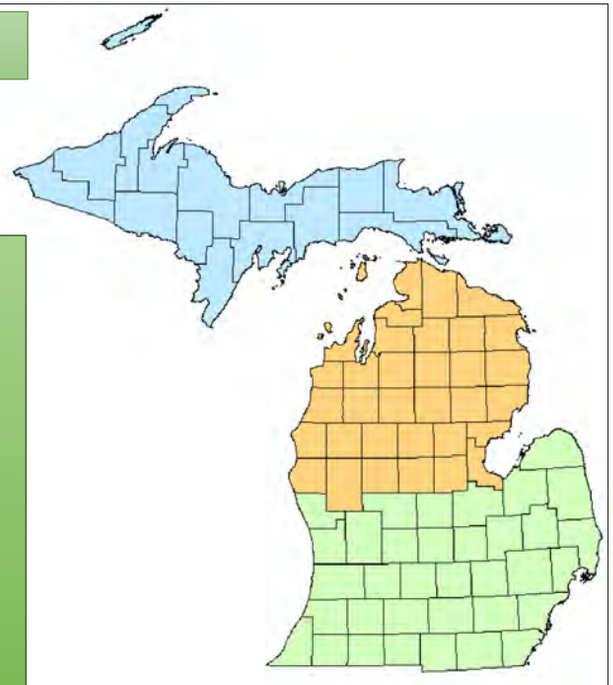
In 2018, researchers from Michigan State University surveyed white pine stands in the eastern Upper Peninsula and the northern Lower Peninsula to determine the distribution of *Caliciopsis*, identify site factors that may predicate disease and to collect more samples to help us characterize the fungal pathogen causing the disease. *Caliciopsis* fruiting bodies (ascocarps) were found in 17 out of 24 surveyed counties. The presence of the fruiting bodies was not always accompanied by an excessive outflow or resin or lower branch dieback, symptoms typical of *Caliciopsis* canker disease. Multiple species of *Caliciopsis* may be present in Michigan, including *C. pinea* which is responsible for eastern white pine disease and mortality in New England and the Southern Appalachians. In Michigan, the presence of *Caliciopsis* appears to be associated with high densities of white pine trees, especially on wetter sites. Further

White Pine Decline

analysis of the survey data may reveal more site- and stand-level factors that may predict this disease.

From 1998-2000, researchers from Michigan State University, the Michigan Department of Natural Resources and the United States Forest Service planted eastern white pines in experimental sites to assess ways to minimize the effects of white pine weevil on white pine regeneration. These sites were revisited in 2017 to assess pine survival, radial growth and defects. We found that when planted under an oak canopy, eastern white pine grew slowly but with few defects. In even-aged mixed species plantings, eastern white pine had highly variable growth rates and levels of defects, possibly due to site conditions and species composition. In an open plantation, eastern white pine tended to have fewer defects and less radial growth when planted at higher densities.

MICHIGAN DNR FOREST HEALTH



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